

Comprehensive Report to Congress Clean Coal Technology Program

Advanced Coal Conversion Process Demonstration

**A Project Proposed By
Western Energy Company**



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1.0 EXECUTIVE SUMMARY

The FY 86 Appropriations Act, P.L. 99-190, included approximately \$400 million to support the construction and operation of demonstration facilities using Clean Coal Technologies. The Clean Coal projects cover a broad spectrum of technologies having the following things in common: (1) all are intended to increase the use of coal in an environmentally acceptable manner; and (2) all are ready to be proven at the demonstration level.

In response to the resulting Program Opportunity Notice (PON), 51 proposals were received in April 1986. After evaluation, nine projects representing seven different technologies were selected in July 1986 for funding under the Clean Coal Technology (CCT) Program. In addition, a list of alternative candidates was established from which replacement selections could be made should any of the original nine not proceed to award. On October 7, 1987, and subsequently on December 9, 1988, as a result of project sponsors withdrawing their proposals or the Department of Energy (DOE) terminating negotiations, DOE selected, respectively, four additional and three additional projects from the alternative candidates list.

One of the alternative projects selected was the Advanced Coal Conversion Process (ACCP) demonstration proposed by Western Energy Company (WECO), a subsidiary of Entech, Inc., the non-utility group of Montana Power Company. This project will demonstrate an innovative technology to enhance the thermal and environmental value of low-rank subbituminous and lignite coals.

This technology consists of supplying raw coal to a first-stage, vibratory fluidized-bed reactor, which removes loosely held water from the coal. The coal then enters a second-stage, vibratory fluidized-bed reactor, where tightly held (chemically bound) water, carboxyl groups, and volatile sulfur compounds are removed. The coal is then cooled in a vibratory fluidized-bed cooler. Coal exiting from the cooler is transported through vibrating screens and fluidized-bed separators for removal of pyritic sulfur and ash-forming minerals.

Low-rank western coals normally contain 25 to 55 percent moisture and 0.5 to 1.5 percent sulfur, and have heating values of 5500 to 9000 Btu/lb. The net result of WECO's Advanced Coal Conversion Process is that such coals will be upgraded. Moisture content will be reduced to as low as 1 percent, sulfur content will be reduced to as low as 0.3 percent, and the heating value will be increased to about 12,000 Btu/lb.

The enhanced coal will permit the use of the large western U.S. reserves of low-rank coal in a wider selection of existing facilities in an environmentally and economically acceptable manner. Because of its low sulfur content, the enhanced coal could allow many older plants to remain in operation that would otherwise be shut down or require expensive sulfur control systems.

The project will be conducted at WEC's Rosebud Coal Mine. The mine is located near Colstrip, Montana, as shown in Figure 1.

This demonstration project will be performed over a 66-month period and includes design, site preparation, installation of equipment, facility operation, coal testing, data analysis, and reporting of results.

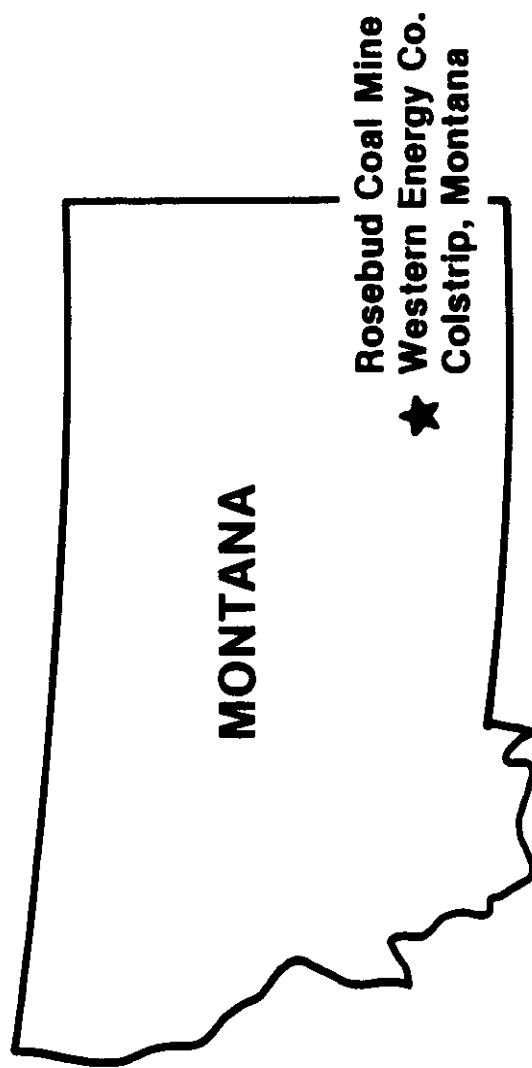
The total project cost is \$69 million. The co-funders are DOE (\$34.5 million) and WEC (\$34.5 million). Operational testing is scheduled to begin in 1993. Overall project completion is scheduled to occur in 1996.

2.0 INTRODUCTION AND BACKGROUND

The domestic coal resources of the United States play an important role in meeting current and future energy needs. During the past 15 years, considerable effort has been directed toward developing improved coal combustion, conversion, and utilization processes to provide efficient and economic energy options. These technology developments permit the use of coal in a cost-effective and environmentally acceptable manner.

2.1 Requirement for Report to Congress

In December 1985, Congress made funds available for a Clean Coal Technology (CCT) Program in Public Law No. 99-190, An Act Making Appropriations for the Department of Interior and Related Agencies for the Fiscal Year Ending September 30, 1986, and for Other Purposes. This Act provided funds "... for the purpose of conducting cost-shared Clean Coal Technology projects for the construction and operation of facilities to demonstrate the feasibility for future commercial applications of such technology..." and authorized DOE to conduct the CCT program. Public Law No. 99-190 provided \$400 million "... to remain available until expended, of which (1) \$100,000,000 shall be immediately available; (2) an additional \$150,000,000 shall be available beginning



**FIGURE 1. WECO ACCP DEMONSTRATION PROJECT
LOCATION.**

October 1, 1986; and (3) an additional \$150,000,000 shall be available beginning October 1, 1987." However, Section 325 of the Act reduced each amount of budget authority by 0.6 percent so that these amounts became \$99.4 million, \$149.1 million, and \$149.1 million, respectively, for a total of \$397.6 million.

In addition, in the conference report accompanying Public Law No. 99-190, the conferees directed DOE to prepare a comprehensive report on the proposals received, after the projects to be funded had been selected. The report was submitted in August 1986 and was titled "Comprehensive Report to Congress: Proposals Received in Response to the Clean Coal Technology Program Opportunity Notice" (DOE/FE-0070). Specifically, the report outlines the solicitation process implemented by DOE for receiving proposals for CCT projects, summarizes the project proposals that were received, provides information on the technologies that were the focus of the CCT Program, and reviews specific issues and topics related to the solicitation.

Public Law No. 99-190 directed DOE to prepare a full and comprehensive report to Congress on any project to receive an award under the CCT program. This report is in fulfillment of this directive and contains a comprehensive description of the Western Energy Company ACCP Demonstration Project.

2.2 Evaluation and Selection Process

DOE issued a Program Opportunity Notice (PON) on February 17, 1986, to solicit proposals for conducting cost-shared CCT demonstrations. Fifty-one proposals were received. All proposals were required to meet preliminary evaluation requirements identified in the PON. An evaluation was made to determine if each proposal met those preliminary evaluation requirements and those proposals that did not were rejected.

Of those proposals remaining in the competition, separate evaluations were made for each offeror's Technical Proposal, Business and Management Proposal, and Cost Proposal. The PON provided that the Technical Proposal was of significantly greater importance than the Business and Management Proposal and that the Cost Proposal's significance was minimal; however, everything else being equal, the Cost Proposal was very important.

The Technical Evaluation Criteria were divided into two major categories. The first, "Commercialization Factors," addressed the projected commercialization of the proposed technology. This was different from the proposed demonstration

project itself and dealt with all of the other steps and factors involved in the commercialization process. The subcriteria in this section allowed for consideration of the projected environmental, health, safety, and socioeconomic impacts (EHSS); the potential marketability and economics of the technology; and the plan to commercialize the proposed technology subsequent to the demonstration project.

The second major category, "Demonstration Project Factors," dealt with the proposed project itself. Subcriteria in "Demonstration Project Factors" allowed for consideration of the following: technical readiness for scale-up; adequacy and appropriateness of the demonstration project; the EHSS and other site-related aspects; and the reasonableness and adequacy of the technical approach and quality and completeness of the Statement of Work.

The Business and Management Proposal was evaluated to determine the business and management performance potential of the offeror, and was used as an aid in determining the offeror's understanding of the technical requirements of the PON. The Cost Proposal was evaluated to assess whether the proposed cost was appropriate and reasonable, and to determine the probable cost of the proposed project to the Government. The Cost Proposal was also used to assess the validity of the proposer's approach to completing the project, in accordance with the proposed Statement of Work and the requirements of the PON.

Consideration was also given to the following program policy factors:

- (1) The desirability of selecting for support a group of projects that represent a diversity of methods, technical approaches, or applications;
- (2) The desirability of selecting for support a group of projects that would ensure that a broad cross section of the U.S. coal resource base is utilized, both now and in the future; and
- (3) The desirability of selecting for support a group of projects that represent a balance between the goals of expanding the use of coal and minimizing environmental impacts.

An overall strategy for compliance with the requirements of the National Environmental Policy Act (NEPA) was developed for the CCT Program, consistent with the Council on Environmental Quality NEPA regulations and the DOE guidelines

for compliance with NEPA. This strategy includes both programmatic and project-specific environmental impact considerations, during and subsequent to the selection process.

In light of the tight schedule imposed by Public Law No. 99-190 and the confidentiality requirements of the competitive PON process, DOE established alternative procedures to ensure that environmental factors were fully evaluated and integrated into the decision-making process to satisfy its NEPA responsibilities. Under terms of the PON, offerors were required to submit both programmatic and project-specific environmental data and analyses as a discrete part of their proposal.

The DOE strategy for NEPA compliance for the CCT Program has three major elements. The first involves preparation of a programmatic environmental impact analysis, for internal DOE use, based on information provided by the offerors and supplemented by DOE, as necessary. This environmental analysis documents that relevant environmental consequences of the CCT Program and reasonable programmatic alternatives were considered in the selection process. The second element involves preparation of a pre-selection project-specific environmental review, also for internal DOE use only. The third element provides for preparation by DOE of publicly available site-specific NEPA documents for each project selected for financial assistance under the CCT Program.

No funds from the CCT Program will be provided for detailed design, construction, operation, and/or dismantlement until the third element of the NEPA process has been successfully completed. In addition, each Cooperative Agreement will require an Environmental Monitoring Plan to ensure that significant site- and technology-specific environmental data are collected and disseminated.

After considering the evaluation criteria, the program policy factors, and the NEPA requirements, proposals from nine offerors were initially selected for award. The proposal submitted by Western Energy was one of the proposals placed on an alternate list, to be eligible for award if one or more of the projects selected did not culminate in an award. In place of a project that did not proceed to an award, the Western Energy Company proposal was selected from the alternate list.

3.0 TECHNICAL FEATURES

3.1 Project Description

The Western Energy Company (WEC) project will demonstrate the feasibility of an advanced coal conversion process to enhance the thermal and environmental characteristics of low-rank subbituminous and lignite coals. The process operates at near atmosphere pressure, thereby eliminating the need for expensive pressure vessels and support equipment. In addition, the process operates in a continuous feed mode rather than a batch mode and can incorporate energy recovery, making it more efficient than conventional evaporative drying processes.

The demonstration will be conducted at WEC's Rosebud Coal Mine. The mine is one of the largest coal mines in the nation and is owned and operated by WEC. The demonstration will be integrated with the existing coal crushing and load-out facilities at the mine.

The goal of this program is to prove the technical, economic and environmental feasibility of the Advanced Coal Conversion Process. If successful, it will produce a stable, upgraded coal product having a moisture content as low as 1 percent, a sulfur content as low as 0.3 percent, and a heating value up to 12,000 Btu/lb.

3.1.1 Project Summary

Project Title: Advanced Coal Conversion Process Demonstration

Proposer: Western Energy Company (WECO)

Project Location: Colstrip, Montana (Rosebud Mine)
Rosebud County

Technology: Advanced Coal Conversion Process

Application: Upgrading low-rank coal

Types of Coal Used: Montana subbituminous and lignite

Product: High-quality fuel for utility and industrial use

Project Size: 45 tons/hr (300,000 tons/yr) product basis

Project Start Date: August 1990

Project End Date: February 1996

3.1.2 Project Sponsorship and Cost

Project Sponsor: Western Energy Company (WECO)

Proposed Co-Funders: U.S. Department of Energy and the Western Energy Company

Estimated Project Cost: \$69,000,000

Cost Distribution:	Participant <u>Share(%)</u>	DOE <u>Share(%)</u>
	50.0	50.0

3.2 Description of Advanced Coal Conversion Process

3.2.1 Overview of Process Development

The initial concept of thermally processing coal with low-pressure, super-heated recycled gas was presented to WECO by an independent consultant in 1981. Under contract to WECO, the consultant continued to develop the conceptual ideas necessary to show the potential benefits of this approach to coal upgrading technology. As those benefits were defined and explored, WECO developed an initial laboratory conceptual design. Equipment was procured, installed and operated to substantiate the theoretical concepts in a bench-scale, batch mode. The results were positive enough to warrant further development.

This led to a contract between WECO and the Montana College of Mineral Science and Technology (Montana Tech) to construct and operate a 200 lb/hr continuous pilot plant. The plant was constructed in 1984 at Montana Tech's Mineral Research Center in Butte, Montana. The primary purpose of the experimental work was to develop a method of thermally processing subbituminous and lignite coal using low-pressure, superheated recycled gas derived from the feed coal to produce a clean, stable product.

Approximately 12 different coals have been tested in the pilot plant. The combined processing experience is in excess of 300 tons of coal and 4,000 operating hours. The product has been tested for storage, handling, transportation, and combustion characteristics. Most of the testing has been performed with Rosebud subbituminous coal.

In addition to the above testing, Combustion Engineering, Inc., has performed comprehensive analytical characterizations of WECO's processed Rosebud coal. The results indicate that the processed coal improved in reduction of moisture content, ash slagging potential, coal abrasiveness, and coal sulfur content.

3.2.2 Process Description

The WECO ACCP consists of a coal supply system, thermal processing system, coal cooling system, coal cleaning system, storage system, heating system, and distillate processing system.

The overall process is shown in Figure 2. In the coal supply system, raw coal from stockpile is screened and fed to the coal processing facility. Coal that is rejected in the screening process is conveyed back to the stockpile for their use.

The coal from the coal supply system enters the thermal processing system, composed of two stages of vibrating fluidized-bed reactors. The first-stage reactor heats the coal, using hot process gas from the heating plant, and removes loosely held water. The second-stage reactor further heats the coal and removes chemically-bound water, carboxyl groups, and volatile sulfur compounds. Electrostatic precipitators to dedust the process gas are included as part of the thermal processing system. The coal exits the second-stage reactor and enters the coal cooling system.

The coal cooling system consists of vibrating fluidized-bed coolers. The coal is cooled by contact with a gas containing primarily carbon dioxide and nitrogen at 100°F. The coal exits the system at approximately 150°F and enters the coal cleaning system. The gas exiting the cooler is at a temperature of about 265°F and is dedusted by electrostatic precipitators and cooled by passing over water-cooled coils.

The coal is then transferred to the coal cleaning system where it is fed to deep-bed stratifiers which use air velocity and vibration to effect rough gravity separation of mineral material (ash) from the coal product. The light-weight fractions from the stratifiers are sent to the product conveyor while the heavy fractions are sent to fluidized-bed separators for further removal of ash from the coal product. Hoods, ductwork, and fabric filters will be used to capture fugitive dust from the coal cleaning area.

Fugitive dust and coal fines from the various units of process equipment are collected and pneumatically conveyed to a briquetting surge bin. The fines are briquetted and conveyed to the storage area as product.

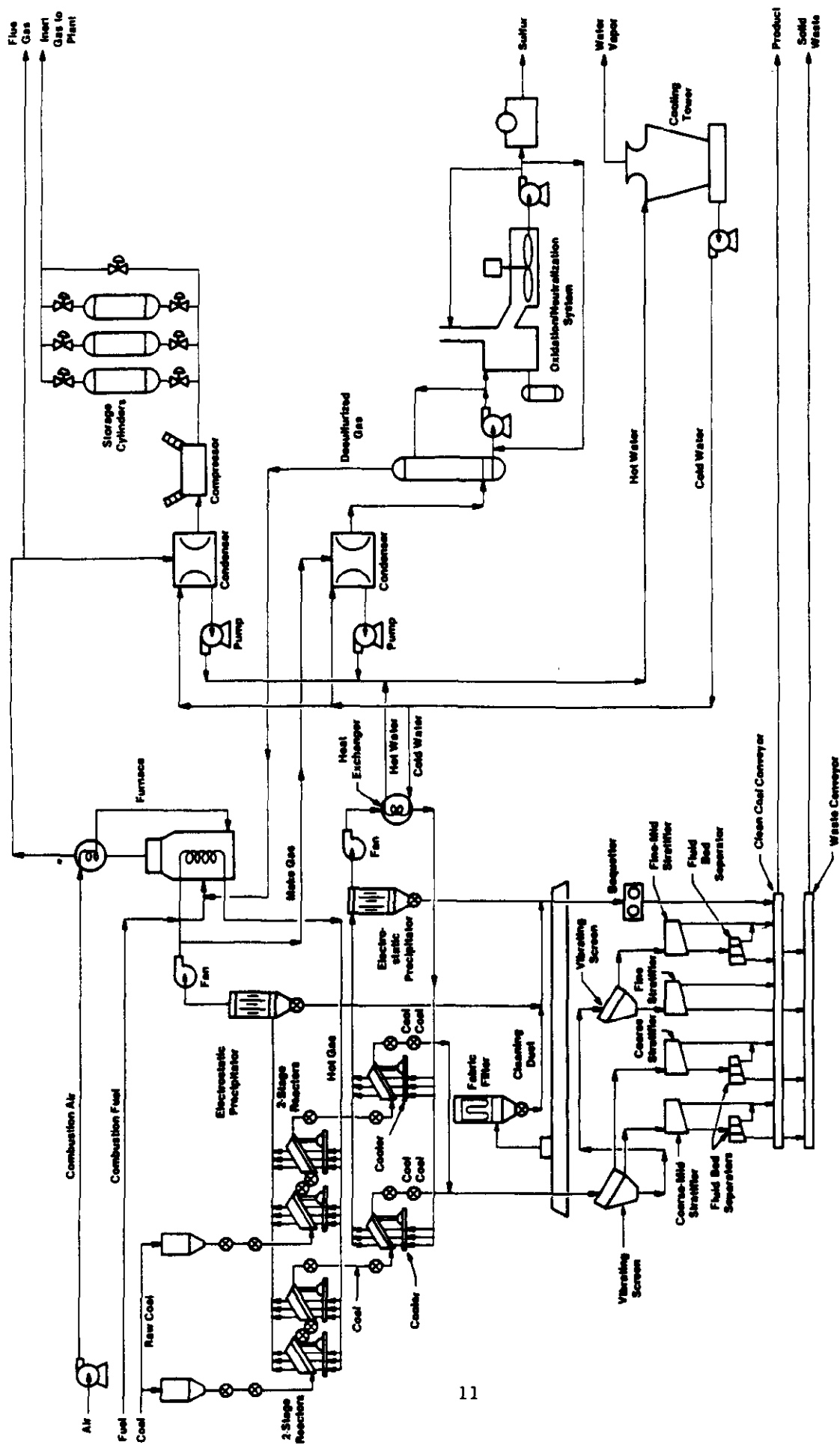


FIGURE 2. OVERALL PROCESS FLOW DIAGRAM.

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The product and the waste from the coal cleaning system are held in the storage area until they are transported off site.

The heat required to process the coal is provided by a furnace. Process gas enters the furnace and is heated by radiation and convection from the burning fuel. The fuel can be coal, oil, gas, etc., as best suits the facility's requirements.

The distillate processing system condenses and separates the water and organic liquids driven from the coal and contained in the process make-gas. Condensation is accomplished using direct contact condensers. Cooling towers are used to dissipate the heat from the condensers and the coal cooling process.

The clean fuel gas from the distillate processing system is burned in the furnace along with the primary fuel. Prior to combustion in the furnace, the sulfur compounds are stripped from the fuel gas by an oxidation/neutralization process. The system is capable of removing 95 percent of the hydrogen sulfide and sulfur dioxide contained in the gas.

Inert gas is used for baghouse pulse cleaning and inerting. It is also used as make-up to the coal cooling and pneumatic conveying systems, and is provided by cooling, compressing, and drying the combustion flue gas in the distillate processing system.

3.2.3 Application of Process in Proposed Project

The demonstration project will be conducted at an active mine owned and operated by WECO and will be arranged as shown in Figure 3.

This project is intended to demonstrate the technical, economic and environmental viability of the ACCP. The vibrating fluidized-bed reactors and associated equipment are the key components of this process and have been used in similar processes. All other ancillary processes that will be used in this project are well established commercial operations. They have been included to provide support to the fluidized bed reactors by preparing and feeding the coal to the process and by processing the product streams.

Specifically, this demonstration will prove that low-rank subbituminous and lignite coals can be upgraded to a product having the following characteristics:

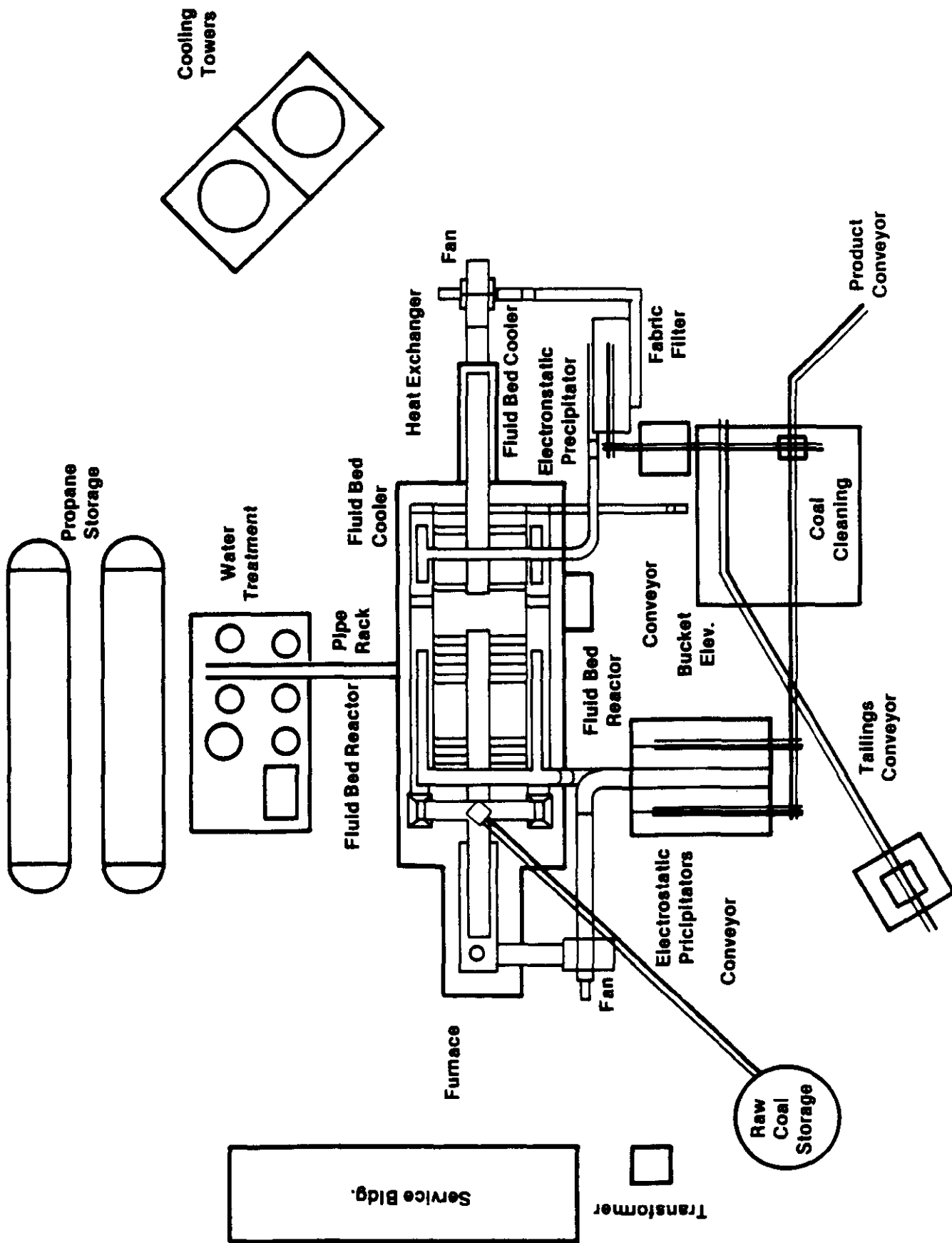


FIGURE 3. WECO ACCP DEMONSTRATION PROJECT FACILITIES ARRANGEMENT.

- o moisture content as low as 1 percent,
- o sulfur content as low as 0.3 percent, and
- o heating values as high as 12000 Btu/lb.

This project will demonstrate that the process can reliably operate in a continuous mode and produce the technical, economic, environmental, and operating data to support commercialization of this technology by the industrial community and the electric power generation industry.

WECo intends to perform additional testing in this plant, which is one-tenth of commercial scale, after the demonstration program is completed. When the facility is no longer considered to be useful, it will be dismantled and the site will be reclaimed in accordance with the State of Montana's reclamation laws.

3.3 General Features of the Project

3.3.1 Evaluation of Developmental Risk

As with any new technology, there is some risk. However, as discussed previously, much prior development work and testing has been performed by WECo. In addition, the technology has been successfully demonstrated in pilot plants.

After reviewing the results of the development work, a low to moderate risk level has been assigned to this project. WECo has been working on the design of the demonstration project since 1986. The vibratory fluidized-bed reactors, the most critical pieces of the process equipment, were selected from commercially available sizes used in similar processes. In addition, all other equipment associated with the proposed project is commercially available and has been operated at the proposed scale and at similar conditions. Further, the results of the pilot-plant tests indicate that there are no outstanding process integration issues and no significant integration risks remaining.

The demonstration facility will be designed so that process parameters, such as particle size, residence times, bed depths, and flow rates, can be varied with minimal operational complications and minimal costs. The various operational tests during the demonstration program may not result in maximum product yields; however, a full range of conditions will be tested.

3.3.1.1 Similarity of the Project to Other Demonstration/ Commercial Efforts

The WECO Advanced Coal Conversion Process dries the coal, liberates the ash particles, and increases the coal's caloric value. The WECO process is somewhat similar to a steam drying process introduced in Austria in 1927 by Hans Fleissner and still in use in Europe. The Fleissner process uses high-pressure and high-temperature steam as the heat transfer medium. Several autoclaves are used, where the blowdown from one is used to preheat a fresh charge in another. This configuration, together with liquid water removal, makes the process thermally efficient. The Fleissner process, however, does not completely stabilize the low-rank coals found in the western United States.

The Koppelman or K-Fuel process is a new drying process that uses a direct contact dryer. This process is similar to the Fleissner process, except that it operates at much higher pressures and temperatures and does not use pure steam for drying. Due to its extrusion discharge process, the dried coal is not cleaned by later processing; however, the product is stable and does not tend to reabsorb moisture.

The WECO process operates at near atmospheric pressures, thereby eliminating the need for expensive pressure vessels and associated support components, and enabling the system to operate in a continuous mode rather than in a batch mode. The process causes the volatile matter to be retained in the solid fuel product. When energy recovery is used, the process is very efficient thermally.

3.3.1.2 Technical Feasibility

The WECO Advanced Coal Conversion Process has been under development since 1981. The technology has been tested and successfully demonstrated in pilot plants. Combustion Engineering, Inc., has tested and characterized the processed coal. The proposed technology uses individual processes and equipment commonly employed in coal cleaning and related industries. Therefore, the individual parts of this process are well proven and available commercially.

There is some risk involved in coupling the separate processes to achieve an integrated, smoothly operating economical production. However, WECO has been improving this technology since its inception. WECO's experience, combined with the success of the pilot-scale tests, indicate that the ACCP is feasible and that this demonstration will achieve its goals.

3.3.1.3 Resource Availability

Adequate resources are available for this program. The demonstration plant will be located at the Rosebud mine owned and operated by WECO, and will be adjacent to the existing load-out facilities.

The feedstock for the demonstration project will be sized and supplied from the existing rail load-out stockpile. Electrical power supply will be provided via connections to a substation now supplying power to the mine area A.

Approximately 149 skilled laborers will be required for construction of the demonstration project. There is a sufficient pool of labor to satisfy this requirement within the local area. In addition, a sufficient pool of labor exists to support the operational labor requirements of the project.

The demonstration project will require approximately 100 gal/min of water as a maximum. This requirement can be satisfied by the Colstrip mine dewatering operation. Fire protection water will be connected with the existing fire protection system at the Area A stockpile and tipple facility.

3.3.2 Relationship Between Project Size and Projected Scale of Commercial Facility

The proposed demonstration will produce 300,000 tons/yr of upgraded coal. The individual capacities of the first commercial plants are estimated to be 1 million to 3 million tons/yr. Most of the equipment needed for these commercial plants is already available at the required sizes. The vibratory fluidized-bed reactors can be scaled to larger sizes based on the coal feed rate per unit of cross-sectional area.

The process equipment for each processing stream will be similar to the equipment designed for the demonstration project. Additional process streams, however, will be required to permit all coal product size fractions to be processed.

Based on the above, the scale-up risk is considered to be minimal and the demonstration is expected to prove the applicability of the technology without further demonstration.

3.3.3 Role of the Project in Achieving Commercial Feasibility of the Technology

The WECO Advanced Coal Conversion Process has the potential to enhance the use of low-rank western subbituminous and lignite coals. The commercialization of the technology, however, requires that additional technical, economical, and environmental data be available to potential users. These data include, but are not limited to: (1) process applicability to various coals, (2) coal cleaning effectiveness, (3) process effectiveness on larger sized coal particles, (4) equipment testing, (5) particle drying as a function of particle size, (6) dried coal properties, (7) extent of increased value of coal to the end user, (8) process operating cost, (9) compliance with operating permit requirements, and (10) compliance with full-scale plant requirements.

3.3.3.1 Applicability of the Data to be Generated

In order to produce accurate and reliable performance data, the demonstration will be fully instrumented and will use automatic data collection techniques. Coal process information will be collected by various temperature, pressure, level, and flow sensors. In addition, laboratory analyses of coal samples before and after drying will be performed. Microprocessor-based central and local control centers will be installed to operate the plant. The central control center will record the information from the various micro-sensors to allow later analysis. Electrical load sensors will be used to determine energy use in the plant.

Stack gas analyzers will be installed on the combustor stack for effluent monitoring. In-plant hydrogen sulfide analyzers will be used to determine the integrity of the drying media containment. Sampling and characterization of those organics and particulates in the stack gas will be performed using standard methods.

Variations in coal heating temperature and residence times will be used to determine rates of particle drying. Dried coal will be chemically and physically analyzed to establish dried coal properties achieved by the different process variations.

During the demonstration project, raw material costs, capital equipment costs, marketing costs, transportation costs, and operation and maintenance costs will be analyzed to ensure that the technology is economically viable.

3.3.3.2 Identification of Features that Increase Potential for Commercialization

Many of the power plants located throughout the upper midwest have cyclone boilers, which burn a low ash-fusion-temperature coal. Presently, most of these plants burn Illinois Basin high-sulfur coal. WECO's processed coal is an ideal low-sulfur coal substitute for these and other plants, because it will allow operation under more restrictive emissions guidelines without requiring derating of the units or the addition of costly flue gas desulfurization systems.

3.3.3.3 Comparative Merits of Project and Projection of Future Commercial Economics and Market Acceptability

The successful demonstration of the WECO Advanced Coal Conversion Process could stimulate increased use of the large reserves of low-rank western coals. These reserves are not now as attractive for utility use at existing facilities, because they normally have a moisture content of 25 to 55 percent and a heating value of only 5500 to 9000 Btu/lb. The WECO process produces a stable, upgraded, coal-fuel product with a moisture content as low as 1 percent, a sulfur content as low as 0.3 percent, and a heating value as high as 12,000 Btu/lb.

Pending acid rain legislation is expected to impose further restrictions on SO₂ emissions. If these restrictions are imposed, the utilities will try to implement changes that are cost effective, and do not require extensive modifications or create operational difficulties. One such alternative will be to use low-sulfur compliance coal.

The WECO process, therefore, will be attractive to the utilities, because the upgraded fuel will be less costly to use than would the construction and use of flue gas desulfurization equipment. This will allow plants that would otherwise be closed to remain in operation. Many of these plants are located in Illinois, Michigan, Minnesota, and Wisconsin and have cyclone-type boilers that burn high-sulfur content Illinois Basin coal. WECO's processed coal is ideal for these plants, because it can be used without requiring derating of the plants or adding flue gas desulfurization equipment.

The potential for the expansion and growth of the processed coal market, especially for Powder River Basin coal, is enhanced because of the large high-quality reserve base, the production of compliance coal, low mining costs, access to existing railroad transportation, and new acid rain legislation.

4.0 ENVIRONMENTAL CONSIDERATIONS

The PON requires that, upon award of financial assistance, the Participant will be required to submit the environmental information specified in Appendix J of the PON. This detailed site- and project-specific information will be used as the basis for site-specific NEPA documents to be prepared by DOE for the selected project. Such NEPA documents shall be prepared, considered, and published in full compliance with the requirements of 40 CFR 1500-1508 and in advance of a go/no-go decision to proceed beyond preliminary design. Federal funds from the CCT Program will not be provided for detailed design, construction, operation, and/or dismantlement until the NEPA process has been successfully completed.

5.0 PROJECT MANAGEMENT

5.1 Overview of Management Organization

The project will be managed by WECO's Project Manager. He will be the principal contact with DOE for matters regarding the administration of the agreement. The DOE Contracting Officer is responsible for all contract matters and the DOE Contracting Officer's Technical Representative (COTR) is responsible for technical liaison and monitoring of the project.

The project will be co-funded by DOE and WECO.

5.2 Identification of Respective Roles and Responsibilities

DOE

The DOE shall be responsible for monitoring all aspects of the project, and for granting or denying all approvals required by this Agreement. The DOE Contracting Officer is the authorized representative of the DOE for all matters related to the Cooperative Agreement.

The DOE Contracting Officer will appoint a Contracting Officer's Technical Representative (COTR) who is the authorized representative for all technical matters and has the authority to issue "Technical Advice" which may:

- o Suggest redirection of the Cooperative Agreement effort, recommend a shifting of work emphasis between work areas or tasks, and suggest pursuit of certain lines of inquiry, which assist in accomplishing the Statement of Work.
- o Approve the technical reports, plans, and technical information required to be delivered by the Participant to the DOE under the Cooperative Agreement.

The DOE COTR does not have the authority to issue any technical advice which may:

- o Constitute an assignment of additional work outside the Statement of Work.
- o In any manner cause an increase or decrease in the total estimated cost or the time required for performance of the Cooperative Agreement.
- o Change any of the terms, conditions, or specifications of the Cooperative Agreement.
- o Interfere with the Participant's right to perform the terms and conditions of the Cooperative Agreement.

All technical advice shall be issued in writing by the DOE COTR.

Participant

The Participant (WECO) will be responsible for all aspects of project performance under this Cooperative Agreement as set forth in the Statement of Work.

The Participant's Project Manager is the authorized representative for the performance of all work to be performed under this Cooperative Agreement. He will be the single authorized point of contact for all matters between the Participant and DOE. The Project Manager will report to WECO's Senior Vice President of Montana/Wyoming Operations on all matters, including project progress, budgets, schedules, contract changes, procedures, and status of relations with DOE.

5.3 Summary of Project Implementation and Control Procedures

All work to be performed under the Cooperative Agreement is divided into three phases. These phases are:

- Phase I: Design and Permitting
- Phase II: Construction and Start-up
- Phase III: Operation and Testing

As shown in Figure 4, each phase will start upon completion of the previous phase. There are no pauses or overlaps anticipated between phases.

Budget periods will be established which coincide with project phases. Consistent with Public Law No. 99-190, DOE intends to obligate funds sufficient to cover its share of the cost of each budget period. Throughout the course of this project, reports dealing with the technical, management, cost, and environmental monitoring aspects of the project will be prepared by WECO and will be provided to DOE.

5.4 Key Agreements Impacting Data Rights, Patent Waivers and Information Reporting

If operation of this facility is successful, WECO is expected to commercialize the ACCP technology through the construction of plants and through licensing the technology to others.

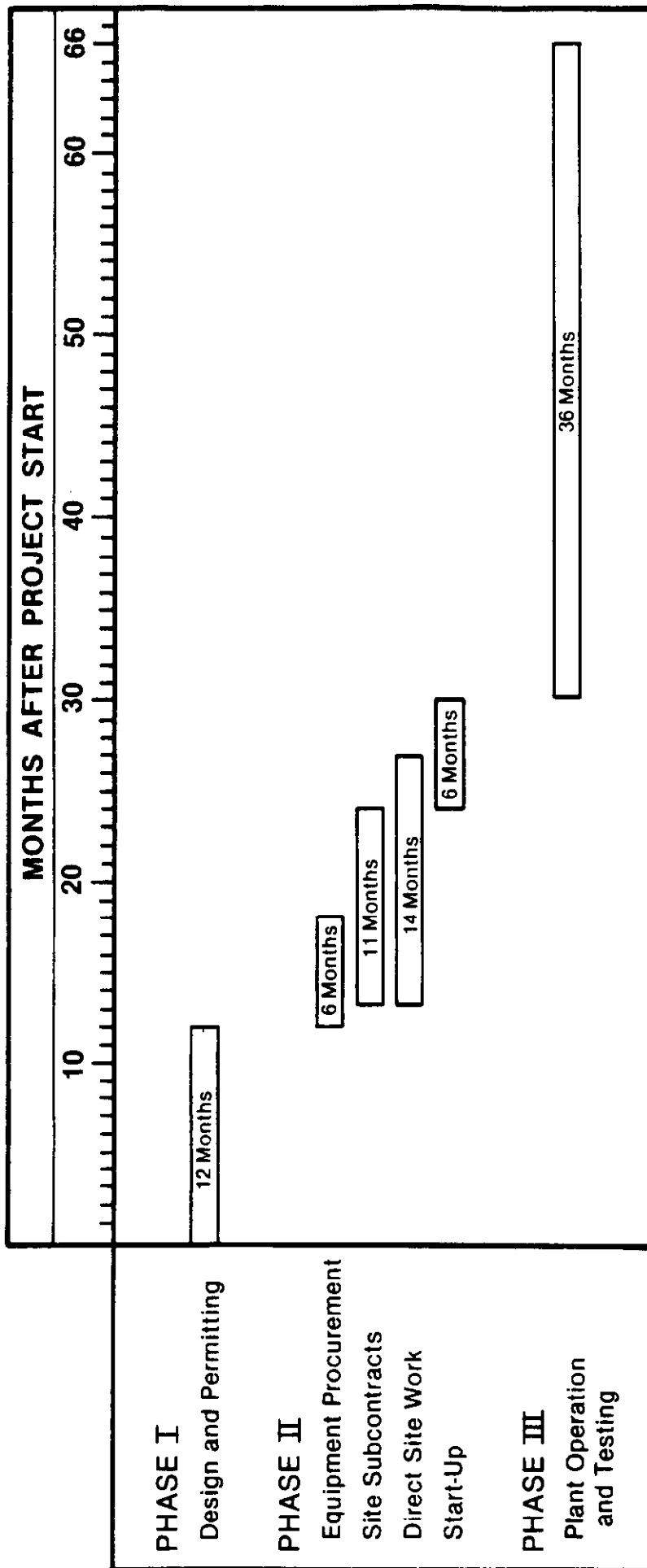


FIGURE 4. OVERALL SCHEDULE FOR ACCP DEMONSTRATION PROJECT.

The key agreements with respect to patents and data are:

- o Standard data provisions are included, giving the Government the right to have delivered and use, with unlimited rights, all contract data that are not proprietary.
- o Proprietary data, with certain exclusions, may be required to be delivered to the Government. The Government has obtained rights to proprietary and non-proprietary data, sufficient to allow the Government to complete the project if the Participant withdraws.

5.5 Procedures for Commercialization of the Technology

The proposed demonstration is the next step in WEC's plan to commercialize the technology. Once the process is proven at the demonstration level, WEC will proceed to actively market it. WEC would like to have a commercial-size facility constructed and operational by 1997. Financing for this plant would be provided based on long-term contracts for sale of the product and, if required, equity capital provided by WEC.

WEC will also market the technology worldwide through licensing agreements with engineering, utility, and other coal mining companies. Its first priority will be to market the technology using its own coal reserves; however, WEC realizes that the process is particularly applicable to utilities with older power plants that require repowering, life extension, and retrofit.

Most of the equipment required for the process is commercially available from existing manufacturers and suppliers. In addition, the engineering and construction of the commercial-scale facilities can be easily accommodated by most of the major engineering and construction firms. Since WEC does not manufacture any equipment, the process technology will be licensed and sold by WEC.

6.0 PROJECT COST AND EVENT SCHEDULING

6.1 Project Baseline Costs

The total estimated cost for this project is \$69,000,000. The Participants' cash contribution and the Government's share in the cost of this project are as follows:

	Dollar Share (\$)	Percent Share (%)
<u>PHASE I</u>		
Government	650,000	50.0
Participant	650,000	50.0
<u>PHASE II</u>		
Government	15,500,000	50.0
Participant	15,500,000	50.0
<u>PHASE III</u>		
Government	18,350,000	50.0
Participant	18,350,000	50.0
<u>TOTAL PROJECT</u>		
Government	34,500,000	50.0
Participant	<u>34,500,000</u>	<u>50.0</u>
Total	69,000,000	100.0

6.2 Milestone Schedule

The overall project will be completed in 66 months after award of the Cooperative Agreement.

Phase I, Design and Permitting, will start immediately after award and continue for 12 months. Phase II, Construction and Startup, will start at the end of Phase I, and continue for 18 months. Phase III, Operation and Testing, will start upon completion of Phase II and continue for 36 months.

6.3 Repayment Plan

In response to the stated policy of the DOE to recover an amount up to the Government's contribution to the project, the Participant has agreed to repay the Government in accordance with a Recoupment/Repayment Plan, which has been included in the Cooperative Agreement.